March 10, 1961

Mr. George L. Hobby
Jet Propulsion Laboratories
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California

Dear George:

I have the accompanying suggestion as a follow-up on our discussion of some simple means of detecting carbonaceous particles for Mariner B. At the very least, we might be able to set upper limits for the density of such particles in the atmospheric dust which would be an important design factor in our later instruments. I think it is possible to use the dielectric breakdown scheme in a rather simpler way than we had discussed before and I would urge you to give it the most careful consideration as a back-up for more complicated experiments.

The basic notion is just as we discussed, namely, to use some oxidized silver or similar salt as a test for pyrolytic carbon, the silver being reduced to a conductive form. Feigl's book on spot tests quotes silver arsenate as a useful material for just such an application on a larger scale. I would propose that we set up a miniaturized conductor pattern by photoprinting the circuit on a quartz plate. The lines can be set up with spacings of no more than a few microns. The plate would then be painted with a thin layer of the silver arsenate or equivalent dielectric indicator. Particles landing on this plate would have little effect on the conductivity registered in the detector circuit unless they cause the breakdown of the dielectric. The same conductors might be used for heating the dielectric using a high frequency discharge across the conductor pattern. The heated particles, breaking down in part to carbon which would then reduce the silver arsenate, would then cause a breakdown of the dielectric which would be picked up in the detector circuit. One could, of course, elaborate this considerably by breaking up the detector patches into a number of independent areas so as to increase the reliability and replication of the tests. All in all, this would make a very compact package, although one admits that its information return is less rewarding than more complex systems. It would be especially advantageous to combine this system with one of moderate power microscopy by incident illumination so that one could also register an impression of the density of dust that was being sampled for its reducing content. Some work should be done on the choice of dielectric materials, testing them against a variety of substances that might give false signals. Other reducing materials, for

example, might be particles of metals, sulfur and some comparable substances. However, without some explicit experience, it is difficult to predict what the sensitivity and selectivity of the method would be. If very fast action on this is needed, it might be advantageous to look immediately for a contractor. If not, we might discuss whether you have the facilities to follow this up yourself or whether we might take it up here. I should stress that one could construct this device so that the detector pattern need take up no more than a fraction of a square centimeter; of course, a number of units could be stacked so as to get independent registers. I do not know what the weight of the circuitry would be but none of the electronics should be very complicated and it should hardly be necessary to establish a completely independent power supply for such a brief and simple requirement. I would not bet for certain that this technique would be sensitive enough to pick up a single bacterium but it might just manage to do so if we can get dielectrics whose breakdown properties are susceptible of careful control.

Another way of doing this is to keep the dielectric hot or active in some other way and register each new particle as it fell as a new AC pulse. But I think we ought to go ahead with some simpler system and be sure that it will work before getting too fancy about it.

Yours sincerely,

Joshua Lederberg
Professor of Genetics

Enc.

P.S. To be fancier still, we make such a plate into the "chemo-conductive" surface of a scanning tube analogous to the vidicon.

P.P.S. If we can double up and time-share another vidicon, Elliot Levinthal suggests that we "scan" for conductivity spots by an electro-luminescent plate, and photograph the light flashes.

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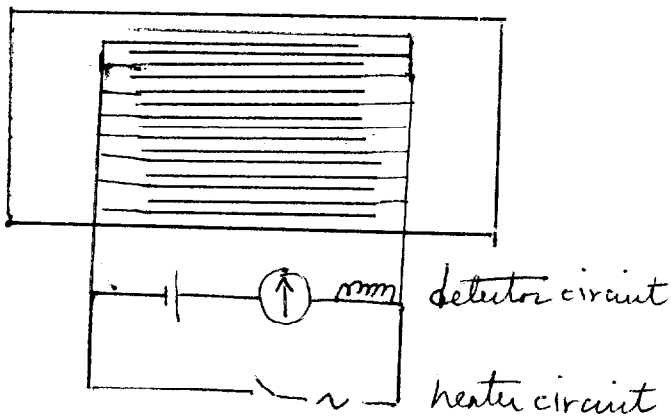
Carbonaceous particle detector
for Fermi B.



Conductor pattern on
quartz plate : > 1000 lines
per cm by photoreduction

Dielectric = Ag_3AsO_4

$Ag_3AsO_4 + C \rightarrow Ag + \ldots$

Detector circuit operates just
under breakdown voltage
of the dielectric

Heater circuit uses AC through
capacitance shunt.